

METHOD FOR MANUFACTURING FUEL INLET

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

[001] The present invention relates to a method for manufacturing a fuel inlet (fuel feed pipe) for feeding fuel such as gas to a fuel tank of a motor vehicle or the like.

2. Description of the Prior Art

[002]¹⁰ Conventionally, an inlet pipe which constitutes a fuel inlet has a shape in which one end of the pipe is eccentrically expanded so that a fuel feed nozzle can be inserted therein, a screw structure is formed in this expanded portion so that a cap can be attached thereto, and a seal portion is formed by curling the end of the expanded portion so as to prevent fuel from leaking between the inside surface of the cap (D1).

15 D1: Japanese Patent Application Publication 2000-334521

[003] The conventional fuel inlet in which a screw structure is formed in an expanded end portion has the following drawbacks:

[004] The end portion becomes non-uniform in thickness or is partially extended in
20 the course of the expanding process. If a screw structure is formed in such a non-uniform portion, the groove portion of the screw structure has an extremely thin thickness or is deformed.

[005] The screw structure formed in the conventional fuel inlet often has a double-start thread structure so that a cap can be attached or removed quickly. The
25 double-start thread structure is obtained by punch (cam-shaped) forming or roll forming as disclosed in the above-mentioned D1. As shown in FIG. 11 (a), in a case where the groove portions of the screw structure are formed to overlap with respect to each other, the amount of the material is small in the overlapping area and the seal portion is partially dented in the axial direction. As shown in FIG. 11 (b), in a case where the
30 groove portions of the screw structure are formed apart with respect to each other, the

amount of the material is large and the seal portion is extended in the axial direction. It might be possible to form the groove portions without overlapping or separating, however this is not always possible depending on the relation to the cap.

5 SUMMARY OF THE INVENTION

[006] To solve the above-mentioned problems, according to a first aspect of the present invention, there is provided a method for manufacturing a fuel inlet comprising the steps of expanding one end of a long-length metal pipe (stainless pipe), cutting off the tip of the long-length metal pipe which becomes non-uniform as a result of the expanding step, forming a screw structure in the end of the long-length metal pipe, cutting off the tip of the long-length metal pipe which becomes non-uniform as a result of the screw structure forming step, and curling the end of the long-length metal pipe which becomes uniform so as to provide a seal portion.

[007] According to a second aspect of the present invention, there is provided a method for manufacturing a fuel inlet comprising the steps of preparing a short-length metal pipe (stainless pipe), one end of which has a small diameter and the other end of which has a large diameter, by conducting a drawing process to a plate or conducting a drawing process or an expanding process to a short-length metal pipe, cutting off the tip of the end having a large diameter of the short-length metal pipe which becomes non-uniform, forming a screw structure in the end having a large diameter of the short-length metal pipe in which the non-uniform tip has been cut off, cutting off the tip of the short-length metal pipe which becomes non-uniform as a result of the screw structure forming step, curling the end of the short-length metal pipe which becomes uniform so as to provide a fuel feed nozzle retaining bracket having a seal portion, and welding the fuel feed nozzle retaining bracket to a long-length metal pipe, one end of which has been expanded.

[008] By cutting off the non-uniform tip of the pipe prior to forming a screw structure, it is possible to form a screw structure in a precise position. Also, it is possible to eliminate the drawback that the thickness of the groove portion of the screw structure will be extremely thin.

- [009] By cutting off the non-uniform tip of the pipe prior to providing a seal portion, it is possible to eliminate the drawback that the seal portion will be partially dented or extended in the circumferential direction.
- [010] It is preferable to cut off the tip of the pipe from the inside diameter side 5 toward the outside diameter side especially in the second cutting-off step. By doing so, when curl forming is conducted to the inlet pipe, burr is allowed to be located in the inside of the curl, and thus, human hands are protected from directly contacting with the burr. Also, there is no fear that the burr will be pinched even if a pipe expanding method having more processes is conducted.
- [011] The screw structure formed in the present invention is not limited to a double-start thread structure, however it should be noted that the present invention is most effective in a case of a double-start thread structure. As a method for forming a double-start thread structure, it is most suitable to form a double-start thread structure by using a main-forming punch and a sub-forming punch in which preliminary forming 15 is conducted by using the sub-forming punch, and thereafter the main-forming punch is advanced.
- [012] Further, it is preferable to divide the seal portion providing step into preliminary forming and finishing forming in which the preliminary forming is conducted in a state where a retaining die is partially inserted into the screw structure 20 and the finishing forming is conducted by using convex and concave dies.

BRIEF DESCRIPTION OF THE DRAWINGS

- [013] The above and other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction 25 with the accompanying drawings.
- [014] FIG. 1 is a diagram showing all processes;
- [015] FIGS. 2 (a) and (b) are entire views of a fuel inlet;
- [016] FIG. 3 is a view explaining the expanding step according to the present invention;
- [017] FIG. 4 is a view explaining the cutting-off step according to the present 30

invention;

- [018] FIGS. 5 (a) and (b) are views explaining the screw structure forming step according to the present invention;
- [019] FIGS. 6 (a) and (b) are views explaining another embodiment of the screw structure forming step;
- [020] FIGS. 7 (a) and (b) are views explaining another embodiment of the screw structure forming step;
- [021] FIG. 8 is a view explaining another embodiment of the screw structure forming step;
- [022] 10 FIGS. 9 (a) and (b) are views explaining a preliminary forming process for providing a seal portion according to the present invention;
- [023] FIGS. 10 (a) and (b) are views explaining a finishing forming process for providing a seal portion according to the present invention; and
- [024] 15 FIGS. 11 (a) and (b) are views explaining the drawback caused in a case where the conventional method is employed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

- [025] Preferred embodiments of the present invention will now be described with reference to the accompanying drawings. FIG. 1 is a diagram showing all processes, 20 and the summary of the method for manufacturing a fuel inlet according to the present invention will be explained below.
- [026] First, a long-length stainless pipe (metal pipe) is prepared, and one end of this pipe is expanded by using a cored bar.
- [027] Next, the tip of the expanded portion which becomes non-uniform as a result of 25 the above expanding step is cut off, and thereafter a screw structure is formed in the expanded portion by using a punch.
- [028] Finally, the tip of the expanded portion which becomes non-uniform as a result of 30 the formation of a screw structure is cut off, and thereafter curl forming is conducted to the tip of the expanded portion which becomes uniform by using a die to provide a seal portion.

[029] FIGS. 2 (a) and (b) are entire views of a fuel inlet manufactured by the present invention.

[030] FIG. 2 (a) shows a case where a screw structure is formed in the pipe body. The fuel inlet is comprised of a stainless inlet pipe 1 and a stainless breather pipe 2 welded to the inlet pipe 1. One end of the inlet pipe 1 is expanded so as to form an expanded portion 3, and a fuel feed nozzle retaining bracket 4 is spot-welded to the inside of the expanded portion 3. A (double-start) screw structure 5 is formed in the expanded portion 3, and a seal portion 6 is formed by curling the tip of the expanded portion 3.

[031]b FIG. 2 (b) shows a case where a screw structure is not formed in the inlet pipe 1. In this case, the screw structure 5 and the seal portion 6 are formed in the fuel feed nozzle retaining bracket 4, and the fuel feed nozzle retaining bracket 4 is arc-welded to the inlet pipe 1.

[032] Next, each process will be explained in detail.

[033]b In the expanding step, a pair of clamping dies 11a, 11b, and a pipe expanding punch 12 are used as shown in FIG. 3. The circumference of the pipe 1 is sandwiched and clamped in a concave groove of a semi-cylindrical shape defined by the clamping dies 11a and 11b. The pipe expanding punch 12, the end of which has a tapered shape, is press-fitted into the pipe 1, and thereby an expanded portion 3 is formed in one end of the pipe 1.

[034] In the tip cutting-off step subsequent to the expanding step, the tip which becomes non-uniform is cut off from the inside diameter side by using a knife 14 in a state where the expanded portion 3 of the pipe 1 is retained by another clamping die 13 as shown in FIG. 4.

[032]b Next, a double-start thread structure 5 is formed in the expanded portion 3, for example, by cam forming. As shown in FIG. 5, a screw structure forming apparatus is comprised of four main-forming punches 15, a pair of sub-forming punches 16 and another pair of sub-forming punches 17. The main-forming punches 15, the sub-forming punches 16 and the sub-forming punches 17 are individually movable back and forth with respect to the center of the pipe 1, which is set in the proper position, by

a hydraulic cylinder unit or the like.

[036] The main-forming punches 15 are in an open state when they are away from the center, and are in a closed state when they move to the center and each punch abuts with the adjacent punches. The main-forming punches 15 have a forming edge 15a, and the radius of curvature of the forming edge 15a is equal to that of the groove portion of the screw structure to be formed. Also, the sub-forming punches 16 and the sub-forming punches 17 which are disposed between the main-forming punches 15 have a forming edge 16a and 17a respectively. The forming edge 16a has a round shape, and the forming edge 17a has the same shape as a portion to be left without being formed.

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[037] In order to form a double-start thread structure in the expanded portion 3 by using the above-mentioned screw structure forming apparatus, the sub-forming punches 16 and 17 are advanced without moving the main-forming punches 15, and thereby preliminary forming is conducted so that the expanded portion 3 is partially dented inward with respect the radial direction as shown in FIG. 5 (a).

[038] Next, as shown in FIG. 5 (b), the sub-forming punches 16 and 17 are moved back, the main-forming punches 15 are advanced, and thereby a screw structure 5, 5 is formed on the circumference of the expanded portion 3, the screw structure 5, 5 being shifted by 180 degrees in the phase with respect to each other.

[039] FIGS. 6-8 show another embodiment of the screw structure forming apparatus. In the embodiment shown in FIG. 6, the screw structure forming apparatus is comprised of a pair of main-forming punches 15 and a pair of sub-forming punches 17 for leaving a portion without being formed. In this embodiment, a portion to be left without being formed is pre-formed by advancing the sub-forming punches 17 as shown in FIG. 6 (a), and thereafter a screw structure 5, 5 is formed by advancing the main-forming punches 15 as shown in FIG. 6 (b).

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[040] In the embodiment shown in FIG. 7, the screw structure forming apparatus is comprised of a pair of main-forming punches 15 and a pair of sub-forming punches 18 for maintaining the outside diameter. In this embodiment, the sub-forming punches 18 are allowed to abut against the circumference of the expanded portion 3 in advance as

shown in FIG. 7 (a), and thereafter a screw structure 5, 5 is formed by advancing the main-forming punches 15 as shown in FIG. 7 (b).

[041] In the embodiment shown in FIG. 8, the screw structure forming apparatus is comprised of just a pair of main-forming punches 15, and a screw structure 5, 5 is formed by advancing the main-forming punches 15.

[042] After the above-mentioned screw structure forming step is finished, the tip of the expanded portion 3 which becomes non-uniform as a result of the screw structure forming step is cut off in the same manner as mentioned above. Next, a seal portion 6 is formed.

[043] Prior to forming the seal portion 6, preliminary forming is conducted as shown in FIG. 9. In the preliminary forming, a clamping die 20 and a cored bar 21 are used, and the tip of the expanded portion 3 is curled in a state where a projection 20a which has been provided in the clamping die 20 is inserted into the groove portion of the screw structure 5. By inserting the projection 20a into the groove portion of the screw structure 5, it is possible to prevent the screw structure from being damaged during the curling. After the preliminary forming is completed, finishing forming is conducted by using a convex die 22 and a concave die 23 as shown in FIG. 10.

[044] In the above-mentioned embodiment, the screw structure is formed in the inlet pipe 1. However, it is also possible to form the screw structure in the fuel feed nozzle retaining bracket 4. In such a case, the screw structure is formed in the fuel feed nozzle retaining bracket 4 in advance, and thereafter the fuel feed nozzle retaining bracket 4 is welded to the inlet pipe 1.

[045] In this connection, the fuel feed retaining bracket 4 is obtained by conducting a drawing process to a plate or conducting a drawing process or an expanding process to a short-length metal pipe.

[046] As mentioned in the above, according to the present invention, when a fuel inlet is manufactured, it is possible to form a screw structure in a precise position by cutting off the tip of the pipe, which has become non-uniform as a result of the pipe expanding step, prior to forming the screw structure. Also, it is possible to eliminate the drawback that the thickness of the groove portion of the screw structure will be

extremely thin. Further, by cutting off the tip, which has become non-uniform as a result of the screw structure forming step, prior to forming a seal portion, it is possible to eliminate the drawback that the seal portion is partially dented or extended in the circumferential direction. Consequently, a fuel inlet having a good sealing property
5 can be obtained according to the present invention.